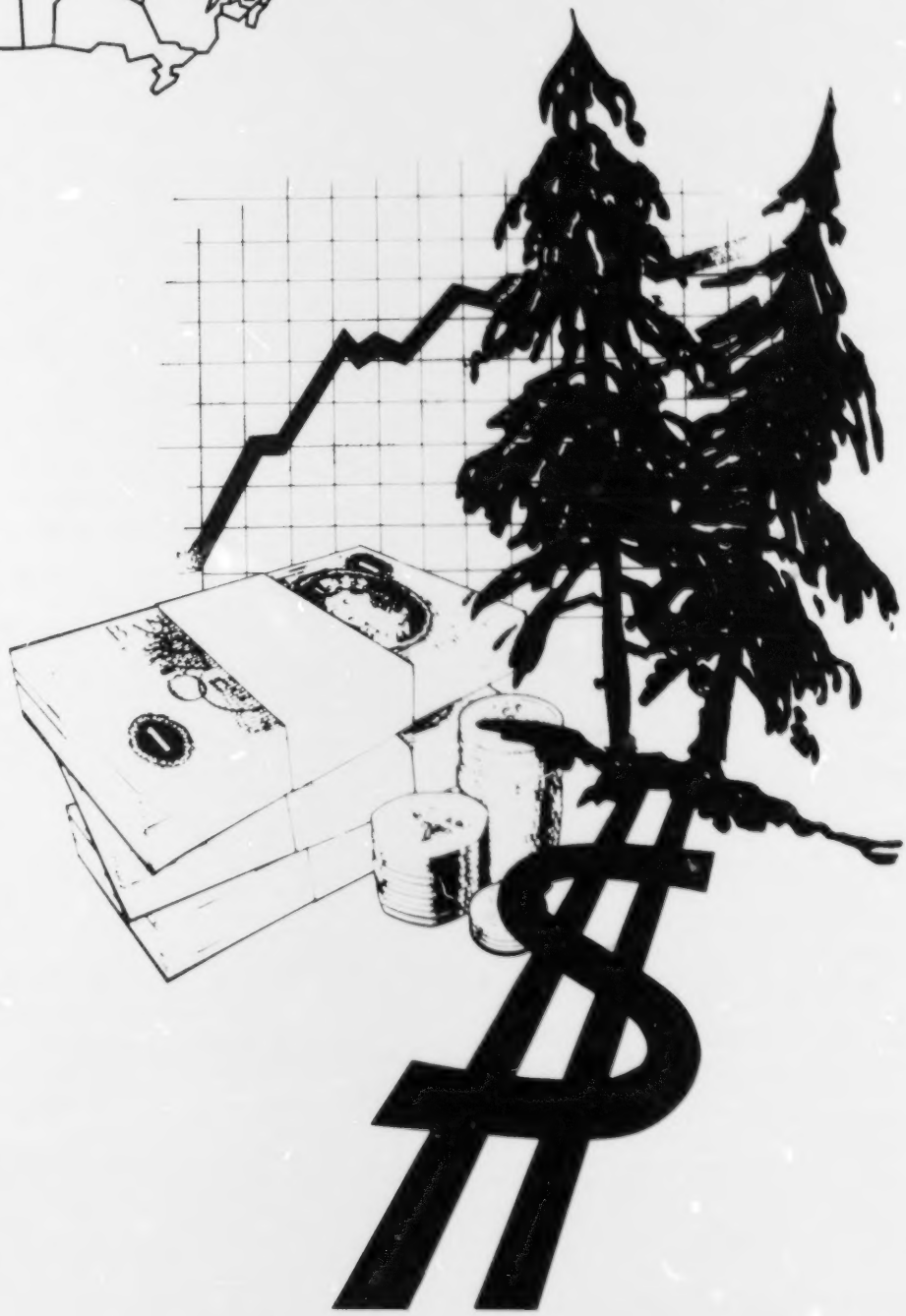

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ALTERNATIVE METHODS OF VALUING COMMERCIAL FOREST RESOURCES IN NEWFOUNDLAND

by G.R. Milne

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ABSTRACT

The value of commercial timber in Newfoundland is represented by stumpage prices which are established as regulated rates, rather than through competitive markets. These prices are low by international standards and reflect government policies at the turn of this century designed to encourage forest industry development. Using stumpage price as a measure of value can hamper internal government economic analyses and policy formulations relating to forestry. Three alternative models to value commercial forests are developed: (1) gross government expenditure; (2) net income value to government; and (3) net social value. Results are derived and compared to stumpage price as a measure of value.

RÉSUMÉ

On évalue ordinairement le bois commercial à Terre-Neuve à partir des droits de coupe, dont la valeur est préétablis et réglementée plutôt que d'être sujotte aux exigences des marchés concurrentiels, car ces droits sont faibles selon les normes internationales, reflétant les politiques gouvernementales du début du siècle visant à encourager l'essor de l'industrie forestière. L'utilisation des droits de coupe comme paramètre de mesure de la valeur risque de nuire aux analyses économiques gouvernementales et à la formulation de politiques touchant les forêts. Trois modèles différents ont été construits pour l'évaluation des forêts commerciales; ils utilisent: (1) les dépenses gouvernementales brutes; (2) la valeur locative nette pour le gouvernement; et (3) la valeur sociale nette. Les résultats qu'ils fournissent sont comparés à ceux obtenus en utilisant les droits de coupe.

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ALTERNATIVE METHODS OF VALUING COMMERCIAL FOREST RESOURCES IN NEWFOUNDLAND

by

G.R. Milne

1.0 INTRODUCTION

Estimating the value of Canada's forest resources has often been a topic of considerable debate between foresters and economists. This debate may take several forms; for example, what is the value of all forest resources in Canada? Or, what is the value of forests used specifically for commercial timber production? Another point raised is the fundamental one of incidence; should a measure of value reflect its worth to industry, government, or society as a whole? Much of the debate has centered on commercial forest resources and their value to both government and the broader concept of society. This fact is not surprising given the vast scale of Canada's forest resources and the importance of the country's large forest industry to the national economy.

At present, the bulk of the forest resources are held under Crown ownership by the ten provincial governments. These governments therefore have responsibility for resource policies within provincial boundaries, including resource pricing. Throughout most of Canada, including Newfoundland, cutting rights to commercial forest resources are rarely sold to private interests through some system of competitive bidding. Instead, cutting rights are often allocated through a mixture of long and short-term tenures with timber prices either negotiated, arbitrarily set by the Crown, or estimated using an appraisal system.

These timber prices (stumpage prices in Canadian terminology) are often felt to be lower than would prevail in a more competitive market for timber where a market price represents an equilibrium in exchange value between buyers and sellers. One consequence of low stumpage prices is that the Crown resource owners may be forfeiting a portion of the resource's full economic rent to industry. Of equal importance is the potential impact from applying these stumpage prices in policy development and analysis. If stumpage prices do represent an inadequate measure of resource value, government policy decisions may be made which are not in the best interests of all Canadians. Examples include inefficient land-use decisions between forestry and competing interests, and less than optimal public investments in forest protection and renewal.

To correct this situation, suggestions are often made for governments to adopt a system of competitive bidding. In theory, the adoption of a system of competitive bidding would improve the economic basis of timber values in Canada; however, the implementation of such a scheme would be difficult. In some regions, developing more competitive markets for timber would be hampered by an insufficient number of mills. Also, a radical shift towards competitive bidding wouldn't alter the realities of an industry presently thought to be harvesting timber at the extensive margin of production. Current stumpage prices may in fact reflect industry competitiveness and the ability to pay for commercial timber. A competitive market would merely verify this situation.

As an alternative, the suggestion has been made that a shadow price should be estimated for commercial timber, in other words deriving

a price that would arise if competitive markets existed. In Newfoundland at least, this approach is greatly constrained by a lack of data on the industry's harvesting and processing costs. By deducting these costs from product values (lumber, pulp, etc.) and allowing a margin for normal profit, a residual value results, reflecting the economic rent of the timber resource. This value can be assumed to represent a fair price which the provincial government could charge industry for commercial timber. However, in the absence of published information on industrial cost structures, these shadow prices are often nothing more than educated estimates.

In discussions of timber prices and resource valuation, a question often raised is whether stumpage prices of any kind are an appropriate criterion for valuing forest resources. One approach in addressing the question of timber values is to ignore stumpage and seek other means of valuing commercial forests. These alternative measures of value could be applied by government to facilitate internal policy analyses and development. This approach would recognize that in many provinces, including Newfoundland, stumpage is a regulated rate and is simply a revenue flowing to the Crown from the industrial use of commercial timber.

The main objective of this paper is to present alternative methods of deriving values within government for commercial forests using Newfoundland as a case study. Chapter 2.0 provides background information on the Newfoundland forestry sector. Chapter 3.0 discusses the theory of forest resource valuation and the current approaches used

throughout Canada, including Newfoundland. Chapter 4.0 provides a description of three alternative models for developing internal government measures of resource value for commercial forests. Results are presented in Chapter 5.0 using data from Newfoundland. Chapter 6.0 compares the strengths and weaknesses of each model according to three criteria; theoretical basis, practical characteristics and policy applications. Chapter 7.0 is a short conclusion.

2.0 THE NEWFOUNDLAND FORESTRY SECTOR

2.1 Labrador's Forest Resource and Industry

The forest resource of Newfoundland is divided into two separate regions, Labrador and the Island (Figure 1). The total productive forest[1] in Labrador on inventoried lands is approximately 3.6 million hectares. Species composition is dominated by softwoods (96%), principally black spruce [Picea mariana (Mill.) B.S.P.] and balsam fir [Abies balsamea (L.) Mill.]. Although the resource base is quite large, accessible timber supplies are widely distributed. Currently, Labrador forests are largely unexploited. The productive forests in the Goose Bay region offer the greatest potential for future industrial development with an annual allowable cut (AAC) of 420 000 m^3. This resource is capable of supporting a pulp mill, for example thermo-mechanical pulp (TMP), with an annual capacity of nearly 150 000 tonnes. Although several firms from Europe and North America have shown an interest in developing this

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[1]Land capable of growing a forest stand of ≥ 35 m^3/ha at maturity.

Figure 1. Productive forest area, Newfoundland and Labrador.

resource potential, no definite proposals have yet been put forward. Reasons for the lack of forestry development in Labrador include poor infrastructure and a short ice-free shipping season. Commercial timber is not presently exported to the Island due to high transportation cost relative to costs of harvesting wood on the Island. This situation could possibly change in the future if timber supply problems develop on the Island. However, at this time any demand for Labrador timber (aside from limited exports to Europe) must originate solely within Labrador.

2.2 The Island's Forest Resource and Industry

The Island's productive forests cover an estimated 2.8 million hectares. The principal species are balsam fir and black spruce, comprising 74% of the forest area. Recent inventory data indicate that the net merchantable volume[2] of standing, living softwoods is approximately 131 million m^3. In addition to this live volume, a further 14 million m^3 of dead and dying softwoods exist in stands comprising a total volume of 37 million m^3. These severe timber losses are largely due to the spruce budworm outbreak between 1972 to 1983. More recently, an outbreak of hemlock looper has exacerbated the budworm damage. These losses represent 19% of the gross merchantable softwood volume on the Island.

The forest sector on the Island consists of industrial and non-industrial timber consumers. The industry is comprised of three large newsprint mills, approximately 1800 small independent sawmills, 90 woodworking plants and supporting logging activity. A small commercial fuelwood industry also exists, serving mainly the St. John's market.

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[2]Gross merchantable volume excluding cull, on slopes < 30% and for stands in excess of 60 m^3/ha.

Non-industrial activity includes forest research, management and a large domestic fuelwood sector. Total industrial and non-industrial timber consumption is about 3.0 million m^3 annually, 90% of which are softwoods. Industrial wood requirements account for 2.0 million m^3 of fibre annually. The forest industry is dominated by the three newsprint mills which utilize 1.7 million m^3 per year of softwood timber. Non-industrial fibre consists mainly of domestic fuelwood.

The forest industry is a cornerstone of the Newfoundland economy. Forestry activity accounts for nearly four percent of total gross domestic product (GDP) in the province and 31% of all exports. Direct and indirect forestry employment represents seven percent of the total employed labor force; direct and indirect forestry income represents eight percent of the provincial total. Throughout the Island, forestry is a major employer in one of every five municipalities.

3.0 FOREST RESOURCE VALUATION

3.1 Theoretical Background

Value can be defined as a continuum over time with net social value (or net social benefits) representing the optimum measure at one end point. In theory, social values relate to a resource or commodity's ability to satisfy human needs and wants (Ferguson and Maurice 1978). Net social value compares the flow of benefits gained by society from a particular resource such as forests, and the costs involved in realizing these benefits. With forests, social benefits include employment and income from timber production (harvesting, processing, etc.) as well as

the private returns to industry. In addition, social benefits include the more difficult to measure extra market benefits such as soil stability, provision of wildlife habitat, recreation and aesthetic benefits, and the return of oxygen to the environment (Nadeau 1981). Social costs on the other hand include the costs of timber production, government expenditures related to forestry, and extramarket costs of environmental impacts incurred during timber extraction and processing.

Social values are difficult to derive in practice and at best can only be estimated. Three main approaches exist for developing social values; by markets, political processes, and judicial decisions (Sinden and Worrell 1979). The first method equates market prices with social value, however even under the assumption of perfect competition, market prices may only indicate minimum social value (Mishan 1975). As these assumptions are relaxed to better reflect economic reality, market prices will increasingly fail to represent social value.

The political approach is often used to value resources that are unsuited to the market process. A government-determined price may be established which mirrors political rather than economic criteria. Assuming government at least partially represents society, these arbitrary prices partially measure social value.

The judicial method is less common, but can be applied when the social value of a natural resource is estimated by the courts during the settlement of a legal dispute between different groups in society. The salient point is that each approach provides an estimate of social value

for a resource, such as forests, which is less than the optimum measure of net social benefits in which all benefits and costs are included.

Where do stumpage prices fit on the social value continuum? The answer depends upon how stumpage prices are derived. In theory, stumpage is the residual or economic surplus calculated from the value of recoverable products such as lumber or newsprint, less all costs of wood harvesting, transportation to mill and processing plus an allowance for profit and risk. Stumpage prices established through a market process best represent this economic surplus or economic rent value. Thus in countries where timber prices are determined through competitive markets, such as Sweden or Finland, the stumpage value reflects the surplus economic value of the resource. However, as indicated earlier, even market prices determined under perfect competition do not correspond to the full social value. Clearly, as timber prices are established through other means such as the political process, the measure of value of the resource falls even further down the value continuum from the optimum point of net social value.

3.2 Forest Resource Valuation in Canada

A range of methods are used by provincial governments in Canada to allocate and price publicly owned forest resources. While moves to increase the level of competition in timber allocation have recently occurred in a few provinces, the political process of resource valuation is the norm. One approach followed is for governments to allocate timber through a lease or license tenure, and charge the tenure-holder a specific price for every cubic metre of timber out. These prices may be

negotiated with the industry, or arbitrarily determined by the provincial government. In addition, prices may be fixed indefinitely, reviewed periodically, or linked to an index of forest product prices, government expenditures, etc.

Another broad although less common approach to forest valuation is through the application of a timber appraisal system. Appraisals attempt to estimate the economic surplus value of specific forest stands by comparing expected product revenues with average production costs (harvesting, transportation, processing), including profit and risk. The resulting surplus value is then used as a stumpage price which the Province can charge the lease or license holder. Both stumpage systems have advantages and disadvantages in terms of complexity, ease of administration, and cost.

Historically, these government approaches to pricing, and hence valuing publicly owned commercial forests have evolved over the past century. During the 1800s the exploitation of the forest expanded as settlement gradually pushed westward across the nation (Reed 1980). Forests were initially used for fuelwood, lumber and naval timber, the latter primarily in Britain. Towards the end of the 19th century, commercial methods were developed for manufacturing pulp from softwoods, an event which precipitated the growth of Canada's pulp and paper industry (Sitwell and Seifried 1984). By the early 1900s, forestry had become a major industrial sector based largely upon exports of lumber and paper products to the United States.

To encourage economic activity in more remote interior and northern regions, provincial governments offered the forest industry long-term leases or licenses with timber provided at low or even zero stumpage prices (Haley 1971). In return for a secure timber supply free from speculative bidding and wild fluctuations, the industry provided the province with economic activity. This emphasis on economic benefits, coupled with the low opportunity cost of forest resources greatly influenced public forest policy regarding timber pricing and values. Present stumpage prices in most provinces are low by international standards (Hagner 1986). Whether these prices accurately reflect the current situation of industry cost structures, timber quality and market prices for final products is still a matter of debate.

3.3 Forest Resource Valuation in Newfoundland

The evolution of forest land tenure and timber valuation in Newfoundland generally follows the pattern which occurred in other regions of Canada. The current structure of resource ownership and pricing mirrors a history of provincial government policies designed to promote regional development through the forestry sector (Munro 1978)[3].

Two of the three newsprint mills on the Island occupy forest land through a mix of freehold, lease and license tenures established in the early 1900s. Under terms of these tenures, stumpage is not paid on the pulpwood harvested. An annual ground rent of \$0.77 per km^2 applies to lease and license lands and a forest protection tax of \$0.32 per

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[3]Readers should refer to Munro's study for a detailed historic analysis of forest land tenure and timber valuation in Newfoundland.

hectare is collected. The more recent third mill is charged stumpage on wood harvested from its license area plus the ground rent and protection tax.

The sawmill industry operates principally on non-tenured or unalienated Crown lands with timber allocated through annual permits. Stumpage is assessed on all wood harvested. The woodworking industry imports most of its raw fibre from the mainland, however, for supplies cut locally (such as birch) stumpage is paid.

Stumpage rates in Newfoundland are legislated by the provincial government (Table 1). The rates are pegged to an index of commodity prices for newsprint and lumber, and an index of government expenditures

Table 1. Stumpage rates, Newfoundland, 1987.

Timber type	Stumpage Rates ($) No existing Gov't. road	 With existing Gov't. road
1. Sawlogs		
a) Hardwood-softwood	5.50/MFBM	7.70/MFBM
b) Pine	11.00/MFBM	13.25/MFBM
2. Construction Timber	4.85/m^3 solid	4.85/m^3 solid
3. Commercial fuelwood	0.70/m^3 stacked	1.10/m^3 stacked
4. Christmas trees	0.10/tree	0.10/tree
5. Pulpwood		
a) Healthy-bark on	1.15/m^3 stacked	2.35/m^3 stacked
b) Healthy-peeled	1.30/m^3 stacked	2.65/m^3 stacked
c) Damaged-bark on	0.75/m^3 stacked	1.15/m^3 stacked
d) Damaged-peeled	0.90/m^3 stacked	1.30/m^3 stacked

Note: Where timber volumes < 60 m^3/ha, stumpage rates are reduced by \$0.30/m^3.

Source: (Anon. 1988).

on goods and services. Thus, stumpage rates are not fixed indefinitely. The magnitude of these stumpage values is comparable to other provinces where legislated rates are used.

3.4 Discussion

Both the federal and provincial governments have historically encouraged forest industry development in more remote hinterland regions. The provinces have clearly supported industrial expansion in the forest sector with the incentive of low-cost timber resources. The implicit exchange of cheap timber in return for socio-economic benefits is well documented in Newfoundland as in other provinces. However, this arrangement has led to stumpage prices which are poor indicators of resource value. This situation is exacerbated in Newfoundland with two of the three newsprint mills not paying stumpage. Using stumpage price as the measure of resource value in government policy formulation and economic analyses may cause inappropriate policy decisions to be made.

As an alternative to resource values represented by politically based stumpage prices, a fourth measure of value, called value-in-use, can be applied. With forest resources, a measure of social value over time can be estimated, based on the resource's contribution to economic welfare such as income, employment or value added. Although these contributions have been well quantified at the national and provincial level, the various socio-economic benefits have not been linked directly to the forest resource. A measure of value-in-use per m^3 or per hectare would be extremely useful as an internal government resource value in policy development. This value however, must not be confused with, or substituted for, current stumpage prices.

4.0 ALTERNATIVE MODELS OF FOREST RESOURCE VALUATION FOR NEWFOUNDLAND

4.1 Background

Three models were developed to value commercial forests in Newfoundland based on the principle of value-in-use (Milne 1986). The underlying foundation of each model is that costs and benefits are incident on both levels of government and the economy as a whole through industrial harvesting and processing of forest resources. Each model yields a measure of social value for commercial forests at both a provincial and a broader federal or national level. Figure 2 summarizes various methods of valuing commercial forests.

4.2 Model 1: Gross Government Expenditure

The first model equates the value of commercial forests in Newfoundland with the level of annual public expenditures to maintain the resource base and related infrastructure such as roads or tree nurseries. This approach has its roots in recreation economics (Seeley 1973) following the theory that costs in some form substitute for benefits, and that measuring costs is easier than measuring benefits (Steiner 1966). By continually committing forestry-related funds from limited public budgets, society, on whose behalf government acts, must be signaling that the forest resource is worth as much as these expenditures.

At the provincial level, the major public expenditures related to commercial forestry are incurred by the Newfoundland Department of Forestry. These expenditures account for all aspects of forest management such as inventory, silviculture, roads, protection, product development and administration. Provincial government funding towards forestry

Figure 2. Alternative methods of valuing commercial forest resources.

1. Market valuation

   Values are represented by an equilibrium price between buyers and sellers in a timber market.

2. Political valuation

   Values are represented by timber prices established by government, for example, legislated stumpage rates for Crown-owned forests.

3. Judicial valuation

   Values of forest resources can often be implied from a court settlement involving preservation of commercial forests or conversely, the loss of formerly reserved forests to logging.

4. Value-in-use

   a) Gross government expenditure

   Forest resource values are equated with the level of annual government expenditures to maintain the forest resource growing stock and related infrastructure such as roads.

   b) Net income value to government

   Forest resource values are derived from the difference in annual government revenues paid by the forest industry (taxes, stumpage, etc.) and gross government expenditures (same as 4a).

   c) Net social value

   Forest resource values are represented by the difference between the annual value added generated by forest industry activity and the gross government expenditure (same as 4a).

education in Newfoundland at both the diploma and degree levels is also included.

At the federal level, the primary public expenditures associated with maintaining the forest resource base and related infrastructure are for research and forestry development. With research, a proportion of the total national Canadian Forestry Service (CFS) budget, including grants and contributions to forestry schools and research institutes (such as FORINTEK) is allocated to Newfoundland. This proportional expenditure is estimated by applying the ratio of productive forest in Newfoundland versus Canada, to the total national CFS research related expenditures. A key assumption is that a proportion of federal research expenditures made outside Newfoundland may yield results applicable within the province. With forestry development, federal expenditures in Newfoundland via cost-shared federal-provincial forestry agreements are included.

While some expenditures of peripheral government departments may be overlooked, the model as described, is felt to capture the bulk of public expenditures to maintain the forest resource base and related infrastructure.

4.3 Model 2: Net Income Value to Government

The second model is based on the concept of net government income from forestry. Gross income is defined as by the public revenues of taxes, fees and royalties paid to government by the forest industry during the harvesting and processing of commercial timber. Costs are the government expenditures derived in Model 1. A net income value results

from the difference between gross income and costs. In Canada, several studies have estimated the gross public income from forestry (see for example Howard 1978; Nadeau 1981; Reed et al. 1973, 1978; White 1982). Most studies however, fail to derive net income values by not deducting a measure of cost from public revenues. As well, where a net value is calculated, the estimates are often biased in favor of revenues. In these cases, public revenues collected from the forest industry firms and employees are included while on the cost side, only government expenditures related to the firm or resource are measured. For balance, government expenditure per employee in education, defense, health and welfare etc., must be estimated. These values are difficult to derive.

This model follows a more practical approach of including public revenues and expenditures related only to forest industry firms, the forest resource, and associated infrastructure. The major provincial government public revenues (or income) paid by the forest industry firms in Newfoundland are corporate income tax, petroleum taxes, retail sales tax, a forest management tax, and various charges for stumpage, licenses and permits. The primary federal public revenues received are corporate income tax and an excise tax. As discussed earlier, costs are represented by government expenditures as estimated in the first model.

4.4 Model 3: Net Social Value

The third model derives a partial measure of net social value by comparing elements of social costs and benefits. Social costs are represented by government expenditures from the first model. This approach is based on the view that government partially represents

society as a whole with respect to forest resources which are owned largely by the Crown.

A wide range of measures can represent social benefits arising from the harvesting and processing of commercial forests, for example employment, income, value added, foreign exchange earnings, etc. In terms of economic theory, value added is the most appropriate measure of social benefits. Value added is an important indicator of local economic activity and also represents an industry's contribution to gross domestic product (Garston and Worton 1968).

Value added is the difference between the net selling price of a finished product such as newsprint, and the costs of purchased inputs. Value added therefore represents the returns to labour (wages and salaries), capital (interest, rent, depreciation) and the firm (profit).

Provincially, a net social value is derived by subtracting provincial government expenditures (Model 1) from the value added generated by the Newfoundland forest industry during timber harvesting and processing. At the federal or national level, a net social value is calculated by deducting the sum of provincial and federal government expenditures (Model 1) from the same value added figure.

4.5 Discussion

The point must be reiterated that none of the models provide a measure of full social value characterized by net social benefits. The models are oriented towards the more easily quantified costs and benefits arising from commercial harvesting and processing of forest resources. Extramarket costs and benefits such as erosion and recreation habitat

should be included to derive full social values, however these are extremely difficult to quantify. Therefore, the models can only yield partial measures of social value for commercial forests.

5.0 RESULTS

5.1 Analytical Approach and Alternate Values

For each model, resource values were derived on a volume (per m^3) and area (per hectare) basis. Published data on commercial timber production in Newfoundland were available for the period 1967 to 1981 (Statistics Canada, Cat. 25-201). Dividing these volumetric data by an average harvest volume per hectare of 104 m^3/ha (Anon. 1981) yielded corresponding estimates of area harvested annually for the same time period (Table 2).

Table 2. Commercial timber harvest, Newfoundland 1967-81.

Year	Production (m^3)*	Area harvested (hectares)
1967	2 098 000	20 173
1968	2 162 000	20 788
1969	2 168 000	20 846
1970	2 702 000	25 981
1971	2 166 000	20 827
1972	2 223 000	21 375
1973	2 810 000	27 019
1974	3 066 000	29 481
1975	2 348 000	22 577
1976	2 238 000	21 519
1977	2 112 000	20 308
1978	2 178 000	20 942
1979	2 254 000	21 673
1980	2 526 000	24 288
1981	2 127 000	20 452

*Source: Statistics Canada, Catalogue 25-201.

The mean annual roundwood production over the 15 year period was 2 345 200 m^3, and ranged from 2 098 000 m^3 to 3 066 000 m^3. The standard deviation of 285 011 m^3 and coefficient of variation of 12.15% reflect relative stability of the data over time.

Resource values were derived in three stages. First, total values were calculated annually over the period 1967 to 1981 for each model at the provincial level, and 1968 to 1981 at the federal level. The difference of one year between each time period is due to a lack of data on federal expenditures for 1967 (Appendix 1). Second, unit values were calculated by dividing the total value each year by the corresponding volume and area of timber harvested (Appendix 2). Thus, resource values were derived on a per cubic metre and per hectare based for every year in both time series. Finally, five year moving averages of values were calculated from the time series results (Table 3).

Table 3. Estimated unit forest resource values based on current consumption, Newfoundland, five-year moving average 1977-81.

Forest resource valuation model	Accounting Stance and Unit Values			
	Provincial		Federal	
	$/$m^3$	$/ha	$/$m^3$	$/ha
1. Gross expenditure	4.10	425.90	3.80	395.60
2. Net income	5.30	552.50	1.20	127.50
3. Net social value	86.10	8954.02	82.30	8558.50

The values in Table 3 represent alternative measures of value-in-use based on the quantity of commercial timber cut each year and corresponding area of forest harvested. The values do not represent the

forest resource base as a whole, only the portion actually consumed by the forest industry. One approach for estimating the value of the total productive forest is to assume that under current policies of sustained yield management, both the level of forest industry output, and the quantity of commercial timber consumed will be maintained in the future, at the average rate calculated for the study periods. Multiplying the average unit value per m^3 estimated for the five-year period 1977 to 1981, by the average annual commercial timber harvest (2 345 200 m^3), results in an estimate of total value for the resource harvested and processed. Under the assumptions stated, this total value-in-use will occur indefinitely into the future. While these assumptions are simplistic, they provide a basis for valuing the entire productive forest on the Island using capital theory. Applying the formula for capital value over an infinite series of rotations (Equation 1) to the total value-in-use for 1977 to 1981, yields an estimate of capital, or present value for the whole productive forest (Table 4). This value, derived for each model, can be transformed to unit values by dividing it by the total productive forest's net merchantable volume of 131 million m^3, and area of 2.8 million hectares (Table 5). While a range of discount rates exist, a real rate of 7.5 percent was chosen as a compromise between the alternative theories of social time preference and social opportunity cost, each with supporting literature.

$$Vo = \frac{a}{i} \qquad \text{(Equation 1)}$$

where Vo = Capital value of the productive forest base generated over an infinite series of rotations

a = Resource value generated by the forest under sustained yield, 1977-1981

i = Real social rate of discount

Table 4. Estimated total capital values of the entire productive, commercial forest, Newfoundland, five-year moving average 1977-1981.

Forest resource valuation model	Total Capital Value ($000 000)	
	Provincial value	Federal value
1. Gross expenditure	128.2	118.8
2. Net income	165.7	37.5
3. Net social value	2 692.3	2 573.5

Table 5. Estimated unit capital values of the entire productive, commercial forest, Newfoundland, five-year moving average 1977-1981.

Forest resource valuation model	Accounting Stance and Unit Values			
	Provincial		Federal	
	$/m^3	$/ha	$/m^3	$/ha
1. Gross expenditure	1.00	45.80	0.90	42.40
2. Net income	1.30	59.20	0.30	13.40
3. Net social value	20.60	961.50	19.60	919.10

5.2 Discussion of Results

5.2.1 Values Based on Current Consumption

Estimates of value based on current consumption of commercial timber (Table 3) reveal several interesting trends. For the gross

expenditure values (Model 1), the results indicate that during the period 1977 to 1981, the provincial and federal governments spent similar amounts to maintain the forest resource and related infrastructure for each m^3 harvested (or hectare cleared). Values based on net income (Model 2), differ greatly between governments. For every m^3 of commercial timber harvested, the provincial government earned more than four times the net public revenues than the federal government. The net social values (Model 3) are comparable for both accounting stances due both to the nature of the calculation and the fact that each level of government spent similar amounts to maintain the forest resource and related infrastructure each year.

The values in Table 3 can be compared with the provincial stumpage prices from Table 1. The stumpage prices are not a representative measure of resource value since two of the three newsprint mills in Newfoundland do not pay stumpage. During the period 1967 to 1981, the average stumpage revenue collected by the provincial government was $362 417. Over the same period, the average volume of commercial timber harvested was 2 345 200 m^3. Therefore, an average stumpage value for the provincial government was $0.15 per m^3. A resource value per hectare is $15.60 based on an average harvest volume of 104 m^3 per hectare. Compared to the results in Table 3, stumpage in Newfoundland is an inadequate measure of resource value according to the methodology employed in this study.

5.2.2 Total Capital Values

The estimates of total capital value for the entire productive forest available for commercial use (Table 4), reflect similar patterns

to the results in Table 3. The reader will recall that the total capital values are derived from the unit values based on current consumption, therefore the similarity between the two data sets is not surprising.

A capital value using a stumpage value of \$0.15 per m^3 and a real discount rate of 7.5 percent is \$4.7 million. This figure is well below those in Table 4 and again illustrates the tendency for stumpage to undervalue the Newfoundland forest resource.

5.2.3 Unit Capital Values

The estimates of unit values based on total capital values (Table 5), follow the same trends as in previous sections. At the provincial level, values per m^3 range from \$1.00 to just over \$20.00 depending upon the model used. Values at the federal level range from \$0.30 per m^3 to just under \$20.00.

Using the total capital value of \$4.7 million based on stumpage (from the previous section), unit capital values of \$0.04 per m^3 and \$1.70 per hectare are derived. These values are very low in comparison to the alternate measures of value in Table 5.

5.3 Time Series Trends - Values Based on Current Consumption

Data for 1967 to 1981 (provincial) and 1968 to 1981 (federal) were used to derive unit resource values based on current consumption. The results in Table 3, representing a five-year moving average (1977 to 1981), were then applied to develop total capital values (Table 4), and unit capital values (Table 5). The trends in unit values based on current consumption, over the entire time series are of particular interest.

5.3.1 Model 1: Gross Government Expenditure

Provincial government expenditures per m^3 of commercial harvest increased in nominal terms from \$1.40 in 1967 to \$5.70 in 1981 (Figure 3). The major upward trend began in 1974 in association with the first in a series of federal-provincial forestry agreements. Expenditures in real terms were derived using the GNE Implicit Price Index, Government Current Expenditure on Goods and Services, 1971 = 100. In real terms, provincial expenditures were fairly stable over the study period around a mean of \$1.51 per m^3.

Nominal federal expenditures per m^3 of commercial harvest increased dramatically in 1974, again in conjunction with the first federal-provincial forestry agreement (Figure 4). As this agreement expired in 1979, federal expenditures declined. A new agreement in 1981 resulted in a significant increase. In real terms (using the same GNE index) expenditures per m^3 followed a similar pattern. Average real federal expenditures were \$1.32 per m^3 over the 14 year period.

5.3.2 Model 2: Net Income Value to Government

Nominal provincial government net income per m^3 generally rises throughout the study period, especially after 1973 (Figure 5). In 1967, the Province realized a negative net income per m^3 of \$-0.39, that is, for every m^3 of commercial harvest by industry, the provincial government spent \$0.39 more on the resource and related infrastructure than it received in various taxes and fees. In 1981 however, the Province received a positive net income of \$7.21 per m^3. The sustained upward trend in nominal net income is due largely to increases in major provincial tax

Figure 3 Provincial government expenditure per m³ production, 1967 to 1981

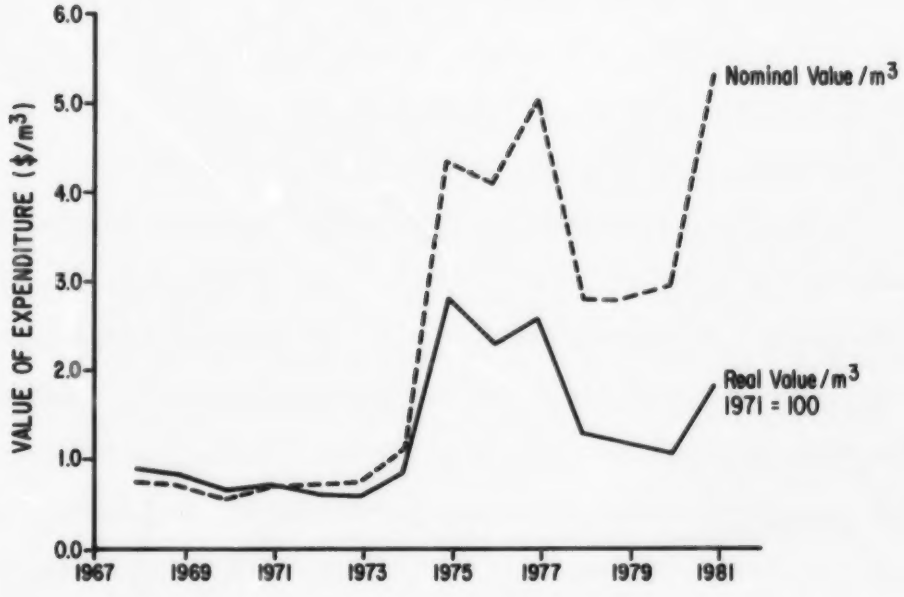

Figure 4 Federal government expenditure per m³ production, 1968 to 1981

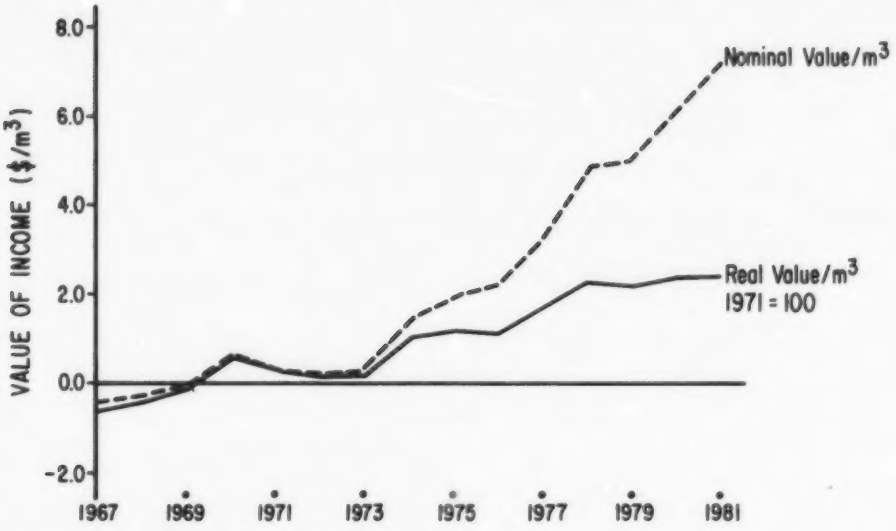

Figure 5 Provincial government net income per m³ production, 1967 to 1981

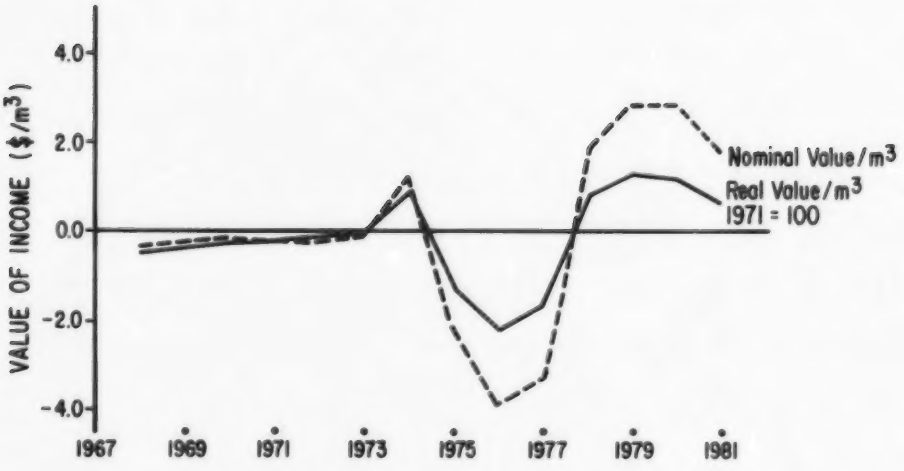

Figure 6 Federal government net income per m³ production, 1968 to 1981

rates and consequently, taxes paid by the forest industry. The forest industry in Newfoundland (as in the rest of Canada) experienced a severe downturn in output due to soft markets. In such a situation, tax revenues would normally decline assuming tax rates were held constant. In Newfoundland however, the increase in provincial tax rates resulted in tax revenues which were insensitive to forest industry output. Real net income values per m^3 (same GNE index used as with Model 1) reflect a similar trend. The average real provincial government net income per m^3 was \$1.01 over the 15 year period.

Federal net income values per m^3 of commercial harvest were very sensitive to market conditions in the forest industry given the sharp decline in net income in 1975 (Figure 6). The range in nominal net income per m^3 was from \$-3.89 to \$2.95. In real terms (same GNE index as above), values ranged from \$-2.19 to \$1.25 per m^3. The average real value over the 14 year period was \$-0.13 per m^3.

5.3.3 Model 3: Net Social Value

Given the nature of the model and the data used, the net social values per m^3 exhibit similar trends for both accounting stances (Figures 7 and 8). At the provincial level, net social values per m^3 of commercial harvest increased in nominal terms from \$26.42 in 1967 to \$114.00 in 1981. Real values were calculated using the Implicit Price Index, Gross National Expenditure. The average real provincial net social value was \$33.54 over the 15 year period.

At the broader federal or national level, nominal net social values per m^3 increased from \$21.73 in 1968 to \$108.64 in 1981.

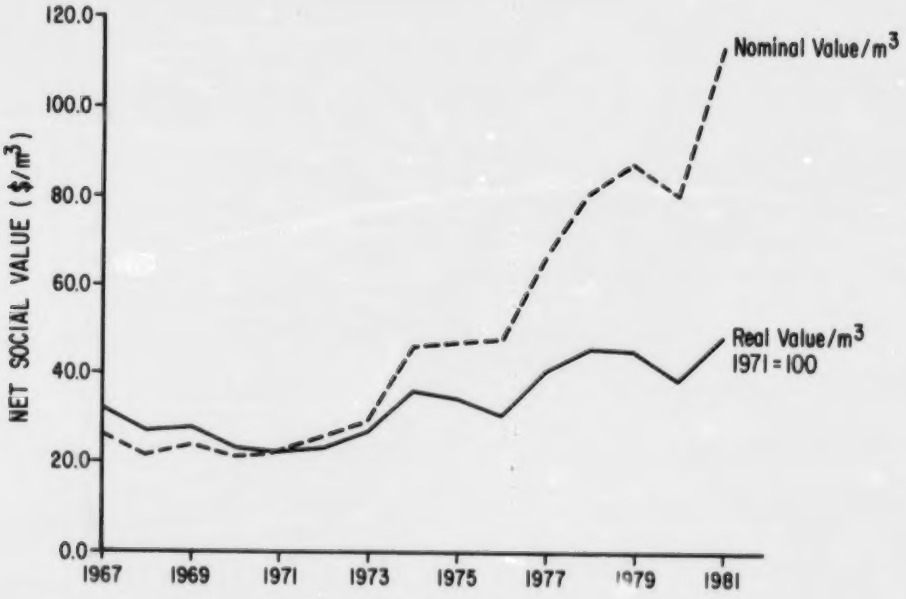

Figure 7 Net social value per m³, provincial accounting stance, 1967 to 1981

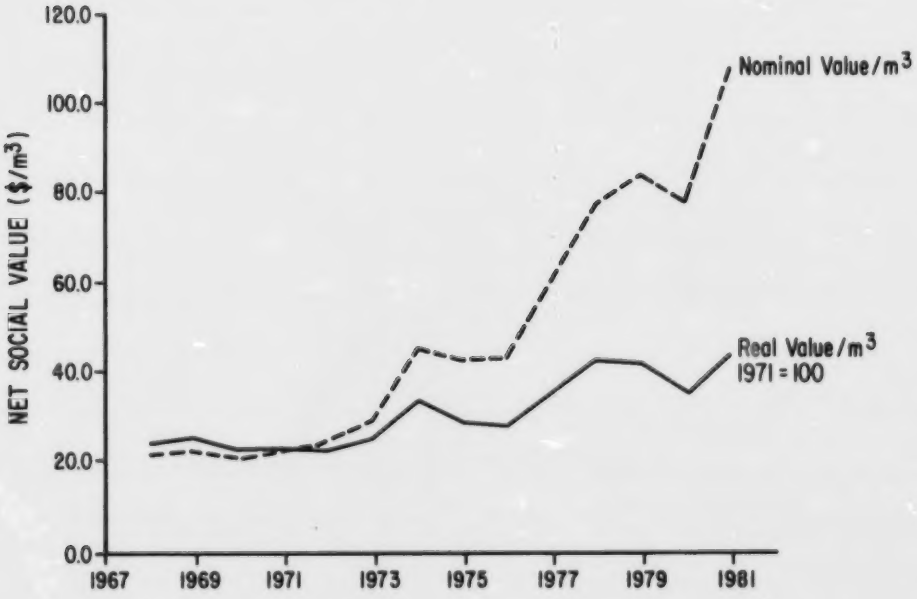

Figure 8 Net social value per m³, national accounting stance, 1968 to 1981

Real values (using previous index) increased from \$24.30 per m^3 in 1968 to \$44.20 in 1981. The average real net social value over the 14 year period was \$31.02 per m^3.

6.0 MODEL COMPARISON

Three criteria to compare the strengths and weaknesses of each model are: 1) theoretical basis; 2) practical characteristics and; 3) policy applications. While other criteria may exist, these three are thought to be sufficient to assess the models developed in this study.

6.1 Theoretical Basis

This criterion refers to the economic soundness of the model in relation to the optimum measure of value, net social benefits, where all costs and benefits incident upon society are quantified. The first model uses only costs, represented by government forestry expenditures, as the measure of benefits arising from the harvesting and processing of commercial timber. Certainly, these expenditures may be of long-term benefit to government and society as a whole by helping to maintain the stock of commercial forest resources. However, in the short-term, industry can continue to harvest and process timber to society's benefit even if these government expenditures are reduced or eliminated. Also, the fact that no actual measure of benefits is used (as opposed to costs) is a disadvantage.

The second model is an improvement over the first model because a net value, represented by the difference between government forestry public revenues and forestry expenditures, is derived. The principal weakness lies in the fact that public revenues are a poor measure of social benefit.

The third model, net social value, offers the best approach in terms of economic theory. Value added provides a reasonable measure of social value from the harvesting and processing of forest resources. The reader is reminded however, that the model does not include all social costs and benefits. Therefore, only partial estimates of net social benefits or net social value are derived.

6.2 Practical Characteristics

Practical characteristics refer to the availability of data required for each model and the ease of estimating the final results. Each of the three models requires a mix of data, available directly from published statistics and estimated indirectly from various published sources. The government expenditure data are important in this study, forming the sole measure of value in the first model, and representing a measure of cost in the other two models. The majority of expenditure data are available directly from published statistics or various government sources. Only the education expenditures in the provincial side of Model 1 were indirectly estimated from published data. Therefore, the process of deriving value estimates for the first model, or calculating total costs for the other two models is relatively simple. However, not all government expenditures relating to forestry were quantified, only those from the provincial and federal "forestry agencies". Thus, the expenditures used in the three models are underestimates. In defence however, the contribution to total government forestry expenditure, from

"non-forestry" departments is thought to be small. As well, these expenditure estimates could not be derived directly from public accounts data. Instead, the information would have to be solicited from the individual departments concerned, a costly and time-consuming exercise with no guarantee of success. In summary, the government expenditure data used in this study are fairly representative of actual expenditures and reflect a good compromise between accuracy, data availability and ease of estimation.

The second model (net income value to government) incorporates these expenditures as a proxy for cost while using public revenues to measure gross income. The main component of public revenues consists of various taxes levied on the forest industry. Generally, no published data are available which refer to the amount of tax paid by a specific industry sector such as forestry for a specific province. Instead, these tax payments must be estimated indirectly, using a wide range of published data. These estimates are subject to a number of assumptions which in some cases are drawn from similar studies in other regions. Also, some estimates of taxes are highly sensitive to changes in assumptions. Using research methods and examples from other studies, estimates of taxes paid by the forest industry can be derived. Assuming that complete, published data are used in deriving these taxes, the results will represent the best possible estimates. Unfortunately for the Newfoundland region this statement is only partially true, since certain background data had to be estimated in addition to the taxes themselves. While the methods used were sound, the fact that gaps in data required

estimation (e.g. fuel consumption, capital and repair expenditures), means that the tax estimates lose even more accuracy. Other regions of Canada have a wider range of published data because the larger scale of their forest industry allows Statistics Canada to publish more complete data. In Newfoundland, several of the required data were confidential. In summary, while the public revenues derived in the second model are fair estimates, availability of data is poor, the calculations are difficult, and many assumptions are required.

The third model (net social value) uses the same government expenditures as a measure of cost. Data for value added are easily obtained directly from published sources. Therefore, the availability of data and ease of estimation are similar in the first and third models. The second model must be viewed less favorably.

6.3 Policy Applications

The criterion of applicability refers to the use of the values per m^3 or hectare, and the time series data in policy analysis. Each of the three models has advantages and limitations in terms of applicability. In the first model (gross government expenditure), one application is to simply provide policy makers in government better information on public expenditures to maintain the forest resource and related infrastructure. The information can be presented either as total expenditure, expenditure per m^3 of wood harvest, or the expenditure per hectare cleared through harvesting. By providing information on current levels of expenditure, government policy makers and politicians could then consider what is an appropriate level of expenditure.

A second policy application is in the negotiation of cost-shared federal-provincial forestry agreements which currently exist in all regions of Canada. From the author's own experience with such agreements in Newfoundland, one of the more difficult policy issues is the negotiation of the expenditure share by each level of government. The establishment of current expenditure levels would make available better information to address this issue. Other criteria are also important and include the cost-sharing ratios from previous forestry agreements in Newfoundland, ratios for new agreements in other provinces, the fiscal capability of each level of government, and the negotiating skill of senior bureaucrats and politicians. Nonetheless, the provision of more information, such as current levels of government forestry expenditure, could allow more effective and perhaps equitable decisions to be made in determining agreement funding levels.

This first model ultimately lends itself to policy applications related to expenditures or funding by governments rather than valuation of forest resources. The lack of any input which measures benefits from the forest, in addition to cost or expenditure, appears to constrain policy applications related to value.

This shortcoming is addressed in the second model, which estimates the net income value of commercial forests to government. By yielding results based on both expenditures and revenues, a wider range of policy applications exist. From primarily a provincial perspective, the net income values can be used in policy applications related to the forest resource, for example protection. With forest protection,

the net income estimates provide a measure of resource value which can be lost to government by failing to protect stands from fire, insects or disease. Given a measure of value and potential loss in value of forests, protection policies can be assessed and adjusted.

Additional policy applications from using the data base relate to comparisons between industrial sectors in one province, or among the forestry sectors in each province at the federal level. With the first example, a province can compare the total net income value between different industries. Dividing total gross income by total expenditure yields a figure which represents public revenue per dollar of government expenditure. Comparing different industrial sectors would illustrate the capability for the generation of net public revenue. Obvious implications for government policy include investment and taxation. A government could invest more public funds in an industry with a high capacity for generating public revenues. Alternatively, an industry which returns little public revenue may not be carrying its share of the provincial tax burden. At the national level, the federal government can compare the public revenue received per dollar of forestry expenditure among the ten provinces. This information could be useful in allocating regional forestry expenditures on the basis of public revenues received.

When considering the policy applications of net income, especially those involved with inter-industry or inter-provincial comparisons, the implicit effect of tax rates must be recognized. The level of net income is clearly affected by tax rates. Therefore, increased net income and hence resource values per m^3 or per hectare can result from

governments' raising tax rates and decreasing expenditures. This strategy is shortsighted and, in the long run, might result in a forest industry unable to generate reasonable profits and compete in world markets. Also, by reducing expenditures on maintaining the forest resource and related infrastructure, a government may ultimately cause a long-term decline in wood supply. For comparisons of net income between industries or provinces, government policy-makers must recognize that differences in net income value may be largely due to differences in tax rates.

The third model (net social value) provides estimates of resource value with a potential for policy applications similar to the second model. The main point of the second model is that it yields values which represent net public revenues to government from harvesting and processing commercial timber. Values from the third model reflect economic activity of the forest industry. Therefore, in the forest protection example, resource values threatened by fire, insects or disease represent potential losses to the economy as a whole rather than potential losses in direct revenues to government. Similarly, for analyzing silvicultural investments to increase forest growing stocks above current levels, the net values produced by this model represent potential gains to society through the eventual harvesting and processing of this incremental volume. For land-use issues between forestry and a competing sector, the government can compare the net social value per hectare, however this type of analysis is restricted to economic activities which ultimately yield a marketable product. Comparing commercial forestry production with recreational uses such as camping or hunting would be extremely difficult.

Other policy applications include comparing the net social value of forest resources between different provinces. In this case, the federal government can use the results as background information when developing investment policies and funding programs for the forestry sector in each province. For interindustry and interprovincial comparisons, government policy-makers may also be interested in assessing the share of value added among labor in the form of wages, and industry in the form of profits. The percentage of labour income from total value added for example, can be a useful measure of local employment input and hence regional economic activity.

The data base for each model could also be useful in the analysis of forestry policy. The time series data provide trends in value based on current consumption of commercial forests, both in nominal and real terms. This information can be applied when making forecasts. With the first model, forecasts of government expenditure related to maintaining the forest resource and related infrastructure can be made. Such forecasts would be useful in government planning and budgeting in the short term. These forecasts would require the assumption of no change in government policy regarding funding of forestry programs.

With the second model, forecasts can be made for both government expenditures and public revenues relating to the forestry sector. This information is also of importance in the area of government planning and budgeting. An obvious but necessary assumption is that government policies related to forest sector taxation will remain unchanged over the forecast period.

For the third model, the trends in value added over time are useful as background information in government policy and planning. Given that value added reflects some measure of economic activity and social welfare, an obvious goal of government at both provincial and national levels would be to maintain or even increase value added per m^3. This policy implies increasing the level of wood processing within a province or the nation as a whole. Thus, rather than exporting lumber or market pulp, the industry might be encouraged to exploit markets for laminated wood products, furniture, and fine papers through government policies and programs. The additional processing would result in increased local economic activity as measured by value added.

6.4 Summary

Clearly, each model has advantages and disadvantages using the three criteria chosen. Based on economic theory, the third model (net social value) is the most favorable. In terms of practicality, the first (gross government expenditure) and third models are the better approaches. With the criterion of policy applications, the second (net income value) and third models appear the most useful. A rather subjective assessment would suggest that if one model had to be selected based on these three criteria, the third model (net social value) is the best.

7.0 CONCLUSIONS

In this study, the problem of inadequate forest resource values was identified as a serious constraint on the development of forest sector policy by government agencies in Canada. Currently, most analysts

use stumpage prices as the measure of value for forest resources utilized in commercial production. One important conclusion of this study was that stumpage prices in Canada fail to reflect the full value of commercial timber to both government and more broadly, society as a whole.

The concept of value was defined as a continuum, with net social benefits representing the optimum measure of value at one endpoint. In theory, this point is reached by measuring all benefits and costs incident upon society from a proposed project or ongoing program. As one departs from this point, for example when using values determined by market prices, political process, judicial decisions, or some combination of these, the measure of value is not optimal. In Canada, most provinces continue to use stumpage prices which are either negotiated between industry and government, determined by government alone, or derived through an appraisal system. While recognizing that such stumpage prices are poor measures of social value, the conclusion was also made that this fault would exist with timber prices determined through competitive markets.

Rather than directly addressing the question of what stumpage prices might be under different conditions, or what these prices should be in order to capture full economic rent, this study sought to develop an alternative measure of value of forest resources. The overall objective was therefore to ignore the whole stumpage issue and instead concentrate on deriving a measure of value which reflected the net benefits of commercial forestry activity incident on government and more generally, society as a whole. Given the large scale of public forest

resource ownership and management control in Canada, an urgent need was identified for a measure of value which governments could use in the development of internal policy.

To address this need, three alternate models of resource valuation were derived, based on the principle of value-in-use. The underlying foundation is the fact that benefits to the economy and thus society as a whole arise from the harvesting and processing of commercial timber by the forest industry.

The first model equated the level of benefits received from commercial resource use with the level of government expenditure on maintaining the forest resource base and related infrastructure. The rationale for this model was that by continually committing expenditures in this manner, society, on whose behalf the government acts, must be signalling that the resource is worth as much as these expenditures.

The second model was based on the principle of net benefits. In this case, benefits from resource harvesting and processing were represented by public revenues paid by the forest industry. Costs were represented by government expenditures on maintaining the forest resource base and related infrastructure. Deducting expenditures from revenues yielded a measure of net resource value. Both the first and second models use a provincial and federal accounting stance to reflect the fact that benefits and costs from commercial timber production are incident upon both levels of government.

The third model provided a partial estimate of net social values arising from commercial timber production. Social benefits were

represented by forest industry value added while social costs were the same government expenditures as in the first two models. The third model used a provincial and national accounting stance since net social values from forestry benefit both provincial and national economies.

For each model, data from Newfoundland were used to derive value estimates under a provincial and federal accounting stance. At the provincial level, data from 1967 to 1981 were used; at the federal level, the time series was from 1968 to 1981. Initially, total values were calculated for each model and both accounting stances, for every year in the study period. Unit values were then derived based on the corresponding volume and area of commercial timber harvested. A five year moving average was used to develop estimates of value based on current consumption. These values were applied to the entire productive forest resource using the method of capital valuation and, assuming sustained yield and a real discount rate of 7.5 percent. The resulting total capital values for the full productive forest were then transformed to unit capital values based on the total area and volume of productive forest.

A range of values were developed and compared to estimates of resource value based on current stumpage rates. Stumpage prices clearly undervalued the forest resource in all cases. While the three models have various strengths and weaknesses, they offer government officials at both the provincial and federal levels, alternative valuation approaches for economic analyses, planning, and policy development in the forestry sector.

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Appendix 1. Total resource values - current consumption.

a) Model 1 - Provincial Values

Year	Nominal Expenditure ($)	Implicit Price Index* 1971 = 100	Real Expenditure ($)
1967	2,932,186	77.8	3,768,877
1968	3,130,156	82.2	3,807,976
1969	2,994,845	89.0	3,364,994
1970	1,684,443	94.2	1,788,156
1971	2,889,660	100.0	2,889,660
1972	3,683,877	107.2	3,436,452
1973	4,108,096	116.4	3,529,292
1974	4,427,207	135.1	3,276,985
1975	5,651,341	156.0	3,622,654
1976	6,046,103	177.4	3,408,175
1977	6,572,030	194.5	3,378,936
1978	7,277,128	210.7	3,453,786
1979	9,879,644	229.8	4,299,236
1980	9,955,368	260.0	3,828,988
1981	12,116,558	295.6	4,098,971

*Source: Statistics Canada, Catalogue 13-201, Annual. National income and expenditure accounts. The index is the GNE Implicit Price Index, government current expenditure on goods and services.

b) Model 1 - Federal Values

Year	Nominal Expenditure ($)	Implicit Price Index* 1971 = 100	Real Expenditure ($)
1968	1,627,101	82.2	1,979,442
1969	1,586,728	89.0	1,782,840
1970	1,586,839	94.2	1,684,542
1971	1,606,995	100.0	1,606,995
1972	1,612,774	107.2	1,504,453
1973	2,097,507	116.4	1,801,982
1974	3,424,685	135.1	2,534,926
1975	10,248,542	156.0	6,569,578
1976	9,376,031	177.4	5,285,249
1977	10,693,493	194.5	5,497,940
1978	6,166,479	210.7	2,926,663
1979	6,338,535	229.8	2,758,283
1980	7,459,136	260.0	2,868,898
1981	11,395,326	295.6	3,854,982

*Source: GNE Implicit Price Index, government current expenditure on goods and services.

c) Model 2 - Provincial Values

Year	Nominal Net Income ($000)	Implicit Price Index* 1971 = 100	Real Net Income ($000)
1967	-826.3	77.8	-1,062.1
1968	-562.4	82.2	-684.2
1969	-78.8	89.0	-88.5
1970	1,632.9	94.2	1,733.4
1971	713.8	100.0	713.8
1972	542.7	107.2	506.3
1973	913.6	116.4	784.9
1974	4,531.2	135.1	3,354.0
1975	4,499.2	156.0	2,884.1
1976	4,796.9	177.4	2,704.0
1977	6,900.9	194.5	3,548.0
1978	10,601.7	210.7	5,031.7
1979	11,389.1	229.8	4,956.1
1980	15,580.3	260.0	5,992.4
1981	15,326.1	195.6	5,184.7

*Source: Statistics Canada, Cat. 13-201. This is the same Implicit Price Index used to deflate government expenditures.

d) Model 2 - Federal Values

Year	Nominal Net Income ($000)	Implicit Price Index* 1971 = 100	Real Net Income ($000)
1968	-774.5	82.2	-942.2
1969	-590.8	89.0	-663.8
1970	-399.9	94.2	-424.5
1971	-503.7	100.0	-503.7
1972	-511.0	107.2	-476.7
1973	-554.0	116.4	-475.9
1974	4,147.0	135.1	3,069.6
1975	-4,946.7	156.0	-3,171.0
1976	-8,698.9	177.4	-4,903.6
1977	-6,937.0	194.5	-3,566.6
1978	3,972.1	210.7	1,885.2
1979	6,656.6	229.8	2,896.6
1980	7,397.5	260.0	2,845.2
1981	3,632.5	295.6	1,228.9

*Source: Statistics Canada, Cat. 13-201. This is the same Implicit Price Index used to deflate government expenditures.

e) Model 3 - Provincial Values

1. Calculation of real value added.

Year	Nominal Value Added* ($000)	Implicit Price Index** 1971 = 100	Real Value Added ($000)
1967	58,351	85.9	67,929.0
1968	51,728	88.7	58,318.0
1969	55,097	92.6	59,500.0
1970	60,950	96.9	62,900.0
1971	53,446	100.0	53,446.0
1972	59,949	105.0	57,094.3
1973	87,785	114.6	76,601.2
1974	146,603	132.1	110,979.0
1975	115,651	146.3	79,050.6
1976	111,198	160.4	69,325.4
1977	146,047	172.3	84,763.2
1978	185,019	183.8	100,663.2
1979	207,373	202.7	102,305.4
1980	215,100	225.8	95,261.3
1981	254,596	249.7	101,960.8

*Source: Statistics Canada, Cat. 25-202.

**Source: Statistics Canada, Cat. 13-201, index is the Implicit Price Index, Gross National Expenditure.

.../Cont'd.

e) Model 3 - Provincial Values (Cont'd.)

2. Calculation of net social value, nominal data.

Year	Nominal Value Added ($000)	Provincial Gov't. Expenditures ($000)	Net Social Value ($000)
1967	58,351	2,932.2	55,418.8
1968	51,728	3,130.2	48,597.8
1969	55,097	2,994.8	52,102.2
1970	60,950	1,684.4	59,265.6
1971	53,446	2,889.7	50,556.3
1972	59,949	3,683.9	56,265.1
1973	87,785	4,108.1	83,676.9
1974	146,603	4,427.2	142,175.8
1975	115,651	5,651.3	109,999.7
1976	111,198	6,046.1	105,151.9
1977	146,047	6,572.0	139,475.0
1978	185,019	7,277.1	177,741.9
1979	207,373	9,879.6	197,493.4
1980	215,100	9,955.4	205,144.6
1981	254,596	12,116.6	242,479.4

..../Cont'd.

e) Model 3 - Provincial Values (Concl'd.)

3. Calculation of net social value, real data.

Year	Real Value Added ($000)	Real Provincial Gov't. Expenditures ($000)	Real Net Social Value ($000)
1967	67,929.0	3,768.9	64,160.1
1968	58,318.0	3,808.0	54,510.0
1969	59,500.0	3,365.0	56,135.0
1970	62,900.0	1,788.2	61,111.8
1971	53,446.0	2,889.7	50,556.3
1972	57,094.3	3,436.5	53,657.8
1973	76,601.2	3,529.3	73,071.9
1974	110,979.0	3,277.0	107,702.0
1975	79,050.6	3,622.7	75,427.9
1976	69,325.4	3,408.2	65,917.2
1977	84,763.2	3,379.0	81,384.2
1978	100,663.2	3,453.8	97,209.4
1979	102,305.4	4,299.2	98,006.2
1980	95,261.3	3,829.0	91,432.3
1981	101,960.8	4,099.0	97,861.8

f) Model 3 - National Values

1. Calculation of net social value, nominal data.

Year	Nominal Value Added* ($000)	Provincial Plus Federal Gov't. Expenditures ($000)	Net Social Value ($000)
1967	58,531	-	-
1968	51,728	4,757.3	46,970.7
1969	55,097	4,581.6	50,515.4
1970	60,950	3,271.3	57,678.7
1971	53,446	4,496.7	48,949.3
1972	59,949	5,296.7	54,652.3
1973	87,785	6,205.6	81,579.4
1974	146,603	7,851.9	138,751.1
1975	115,651	15,899.9	99,751.1
1976	111,198	15,421.1	95,776.9
1977	146,047	17,265.5	128,781.5
1978	185,019	13,443.6	171,575.4
1979	207,373	16,218.2	191,154.8
1980	215,100	17,414.5	197,685.5
1981	254,596	23,511.9	231,084.1

*Source: Statisitcs Canada, Cat. 25-202.

..../Cont'd.

f) Model 3 - National Values (Concl'd.)

2. Calculation of net social value, real data.

Year	Real Value Added ($000)	Real Provincial Plus Federal Government Expenditures ($000)	Real Net Social Value ($000)
1967	67,929.0	-	-
1968	58,318.0	5,787.4	52,530.6
1969	59,500.0	5,147.8	54,352.2
1970	62,900.0	3,472.7	59,427.3
1971	53,446.0	4,496.7	48,949.3
1972	57,094.3	4,940.9	52,153.4
1973	76,601.2	5,331.3	71,269.9
1974	110,979.0	5,811.9	105,167.1
1975	79,050.6	10,192.2	68,858.4
1976	69,325.4	8,693.4	60,632.0
1977	84,763.2	8,876.9	75,886.3
1978	100,663.2	6,380.4	94,282.8
1979	102,305.4	7,057.5	95,247.9
1980	95,261.3	6,697.9	88,563.4
1981	101,960.8	7,954.0	94,006.8

Appendix 2. Unit resource values - current consumption.

a) Model 1 - Provincial Values

Year	Expenditure per m^3 ($)		Expenditure per ha ($)	
	Nominal	Real	Nominal	Real
1967	1.40	1.80	145.35	186.83
1968	1.45	1.76	150.58	183.18
1969	1.38	1.55	143.67	161.42
1970	0.62	0.66	64.83	68.83
1971	1.33	1.33	138.75	138.75
1972	1.66	1.55	172.35	160.77
1973	1.46	1.26	152.04	130.62
1974	1.44	1.07	150.17	111.16
1975	2.41	1.54	250.31	160.46
1976	2.70	1.52	280.97	158.38
1977	3.11	1.60	323.62	166.38
1978	3.34	1.59	347.49	164.92
1979	4.38	1.91	455.85	198.37
1980	3.94	1.52	409.89	157.65
1981	5.70	1.93	592.44	200.42

b) Model 1 - Federal Values

Year	Expenditure per m^3 ($)		Expenditure per ha ($)	
	Nominal	Real	Nominal	Real
1968	0.75	0.92	78.27	95.22
1969	0.73	0.82	76.12	85.52
1970	0.59	0.62	61.08	64.84
1971	0.74	0.74	77.16	77.16
1972	0.73	0.67	75.45	70.38
1973	0.75	0.64	77.63	66.69
1974	1.12	0.83	116.17	85.99
1975	4.36	2.80	453.94	290.99
1976	4.19	2.36	435.71	245.61
1977	5.06	2.60	526.57	270.73
1978	2.83	1.34	294.46	139.75
1979	2.81	1.22	292.46	127.27
1980	2.95	1.14	307.11	118.12
1981	5.36	1.81	557.17	188.49

c) Model 2 - Provincial Values

Year	Net Income per m^3 ($)		Net Income per ha ($)	
	Nominal	Real	Nominal	Real
1967	-0.39	-0.51	-40.96	-52.65
1968	-0.26	-0.32	-27.05	-32.91
1969	-0.04	-0.04	-3.78	-4.25
1970	0.60	0.64	62.85	66.72
1971	0.33	0.33	34.27	34.27
1972	0.24	0.23	25.39	23.69
1973	0.33	0.28	33.81	29.05
1974	1.48	1.09	153.70	113.77
1975	1.92	1.23	199.28	127.75
1976	2.14	1.21	222.91	125.66
1977	3.27	1.68	339.81	174.71
1978	4.87	2.31	506.24	240.27
1979	5.05	2.20	525.50	228.68
1980	6.17	2.37	641.48	246.72
1981	7.21	2.44	749.37	253.51

d) Model 2 - Federal Values

Year	Net income per m^3 ($)		Net income per ha ($)	
	Nominal	Real	Nominal	Real
1968	-0.36	-0.44	-37.26	-45.32
1969	-0.27	-0.31	-28.34	-31.84
1970	-0.15	-0.16	-15.39	-16.34
1971	-0.23	-0.23	-24.18	-24.18
1972	-0.23	-0.21	-23.91	-22.30
1973	-0.20	-0.17	-20.50	-17.61
1974	1.35	1.00	140.67	104.12
1975	-2.11	-1.35	-219.10	-140.45
1976	-3.89	-2.19	-404.24	-227.87
1977	-3.28	-1.69	-341.59	-175.63
1978	1.82	0.87	189.67	90.02
1979	2.95	1.29	307.13	133.65
1980	2.93	1.13	304.57	117.14
1981	1.71	0.58	177.61	60.09

e) Model 3 - Provincial Values

Year	Value per m^3 ($)		Value per ha ($)	
	Nominal	Real	Nominal	Real
1967	26.42	32.38	2,747.18	3,367.32
1968	22.48	26.97	2,337.78	2,805.37
1969	24.03	27.44	2,499.39	2,854.26
1970	21.93	23.28	2,281.11	2,421.00
1971	23.34	23.34	2,427.44	2,427.44
1972	25.31	24.13	2,632.29	2,510.31
1973	29.78	27.26	3,096.97	2,835.09
1974	46.37	36.20	4,822.62	3,764.42
1975	46.85	33.67	4,872.20	3,501.38
1976	46.98	30.98	4,886.46	3,221.59
1977	66.04	40.13	6,867.98	4,173.88
1978	81.61	46.22	8,487.34	4,806.76
1979	87.62	45.39	9,112.42	4,720.41
1980	81.21	37.71	8,446.34	3,922.15
1981	114.00	47.94	11,856.02	4,985.37

f) Model 3 - National Values

Year	Value per m^3 ($)		Value per ha ($)	
	Nominal	Real	Nominal	Real
1968	21.73	24.30	2,259.51	2,526.97
1969	21.30	25.07	2,423.26	2,607.32
1970	21.35	21.99	2,220.03	2,287.34
1971	22.60	22.60	2,350.28	2,350.28
1972	24.58	23.46	2,556.83	2,439.93
1973	29.03	25.36	3,019.33	2,637.77
1974	45.25	34.30	4,706.46	3,567.28
1975	42.48	29.33	4,418.26	3,049.94
1976	42.80	27.09	4,450.81	2,817.60
1977	60.98	35.93	6,341.42	3,736.77
1978	78.78	43.29	8,192.89	4,502.09
1979	84.81	42.26	8,819.95	4,394.77
1980	78.26	35.06	8,139.23	3,646.39
1981	108.64	44.20	11,298.85	4,596.46